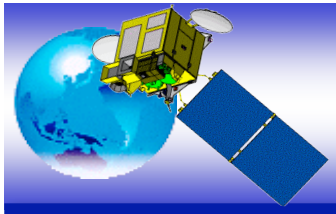


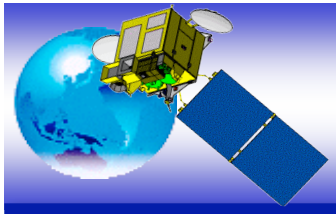
Possibility on GPM GV Joint Research of Korea

Mi-Lim Ou

Korea Meteorological Administration (KMA)

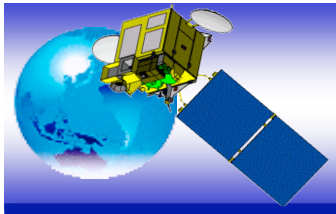
National Institute of Meteorological Research

Seoul, Korea



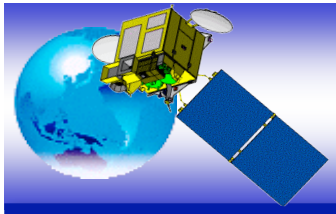
Contents

- Background and Issues
- Climate on Precipitation in Korea
- GPM Functional Concept
- National Observation Network in Korea
- Intensive Observation Sites
- Research Activity in Korea
- Plan for GPM GV in Korea
- Summary and Recommendations



Background

- In Korea, the needs for global precipitation observation with GPM were init ed since 2001.
  - In 2002, NASA/GPM team visited Korea and proposed to join GPM program.
  - Has been discussed to participate in the GPM program among KARI, KMA ar scientists in universities.
- The preliminary study has been performed in 2003.
  - Topic : “Feasibility Study on Maximizing the Benefits from GPM Project”
  - In the study,
    - Investigated necessities of GPM project in the context of academic and social ba rounds
    - Defined GPM-related core technologies and application areas in Korea
    - Prepared the roadmap for the development of the core-technologies
- KMA has participated in the previous GPM GV workshops in 2003 & 2005.
  - KMA expressed already the plan for the Korean GPM based on the intensive ound observation network at that time.



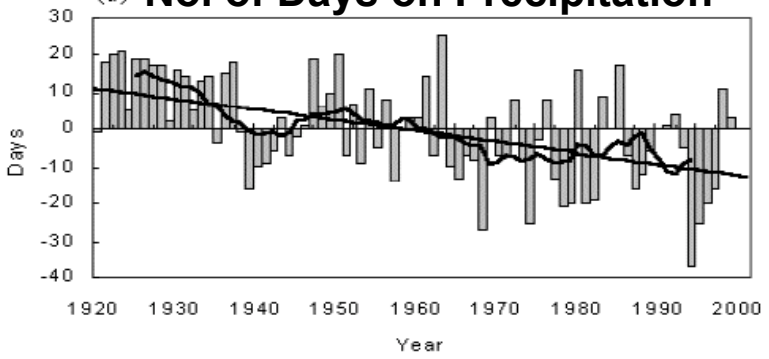
Issues

- **Main Weather Phenomena over Korea**
  - June-July : Rainy season due to Chang-ma front, single storms, MCS..
    - Recently, the rainy season comes early and ends later than normal.
  - End of August – September : Typhoon
  - December – February : Cold and snow season

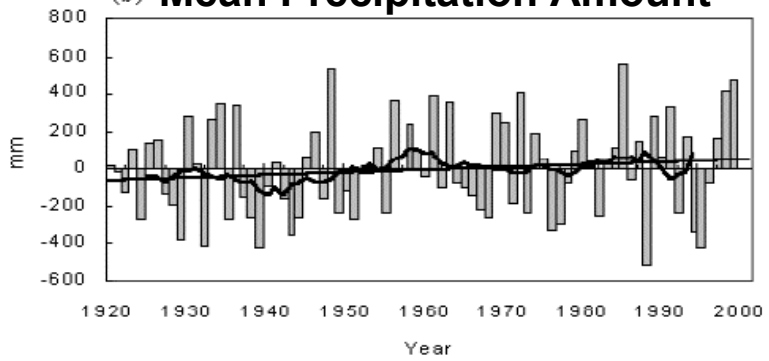
- **Increase of heavy rainfall events & suddenly developed stor**
  - Needs from forecasters have been increased to monitor satellite-based ra all distribution with high resolution in time and space.
  - Plan to produce total rainfall map by merging satellite-based rainfall and r r rainfall
    - Using multi-sensor data including GEO-IR and LEO-MW
    - Starting preliminary study this year.

Climate on Precipitation over Korea

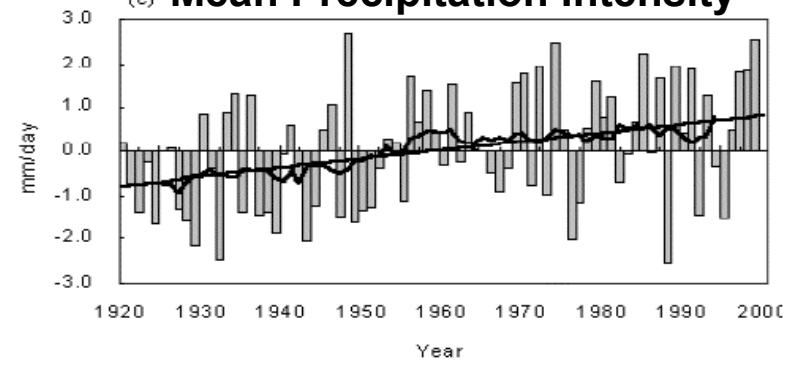
(a) No. of Days on Precipitation



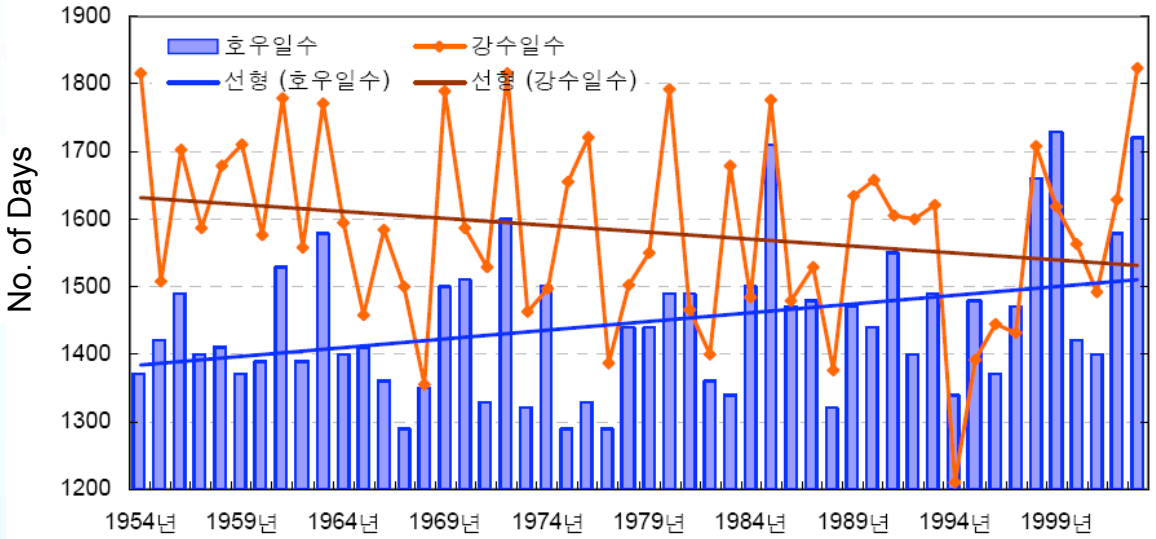
(b) Mean Precipitation Amount



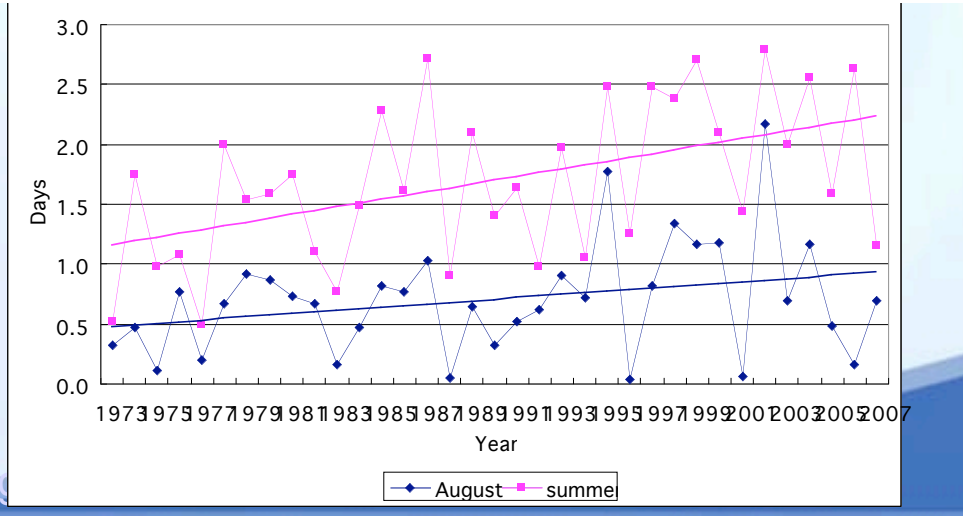
(c) Mean Precipitation Intensity



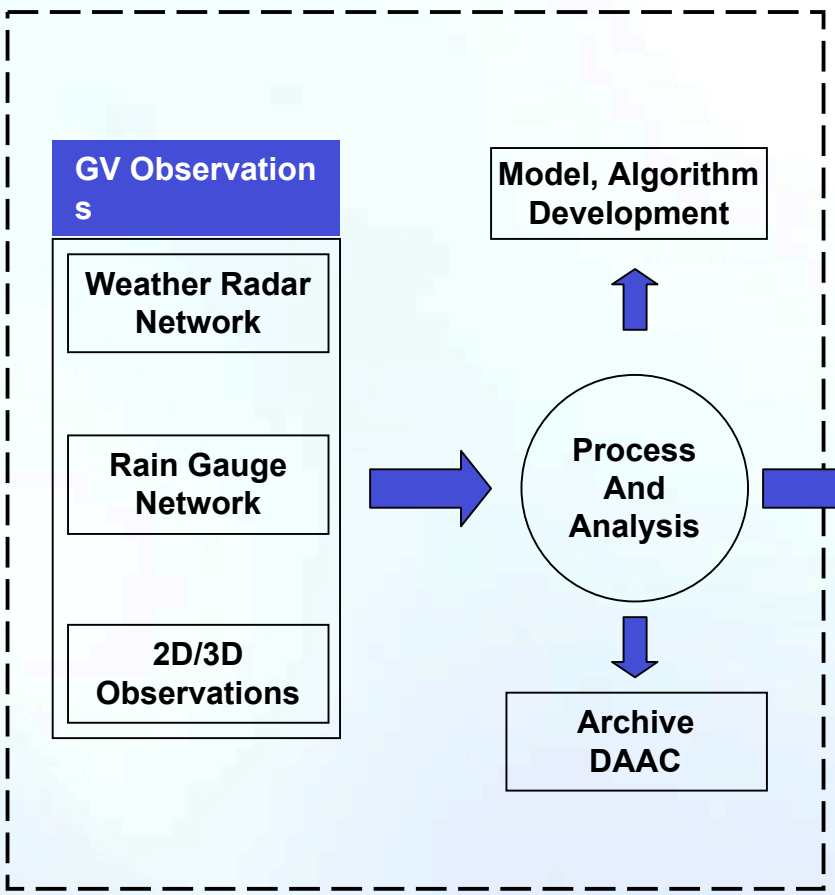
Accumulated Days of Precipitation and Heavy Rainfall for 14 Sites in Korea



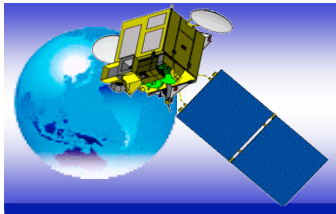
Rainy Days over 80 mm/day during Summer, 1979-20



GPM GV Functional Concept in Korea



KMA as a Potential Regional GPM GV Site



National Observation Network in Korea

- **Dense and Diverse Observation Network**
  - Automatic Weather Stations (AWS)
    - 541 sites on 13 km spacing, 1 min interval
    - 71 Automatic Snow Depth Measurement System (ASDMS)
  - Radar Network
    - 12 sites (1 potable for research), 10 Lightening detect sites
  - Buoy Network
    - 5 sites
  - Intensive Observation Sites
    - 2 sites , KEOP site at Haenam and CPOS site at Daegwallyeong
  - And..
    - 1-base station of Oceanic Meteorological Observation (BOMO)
    - 1-weather vessel in operation

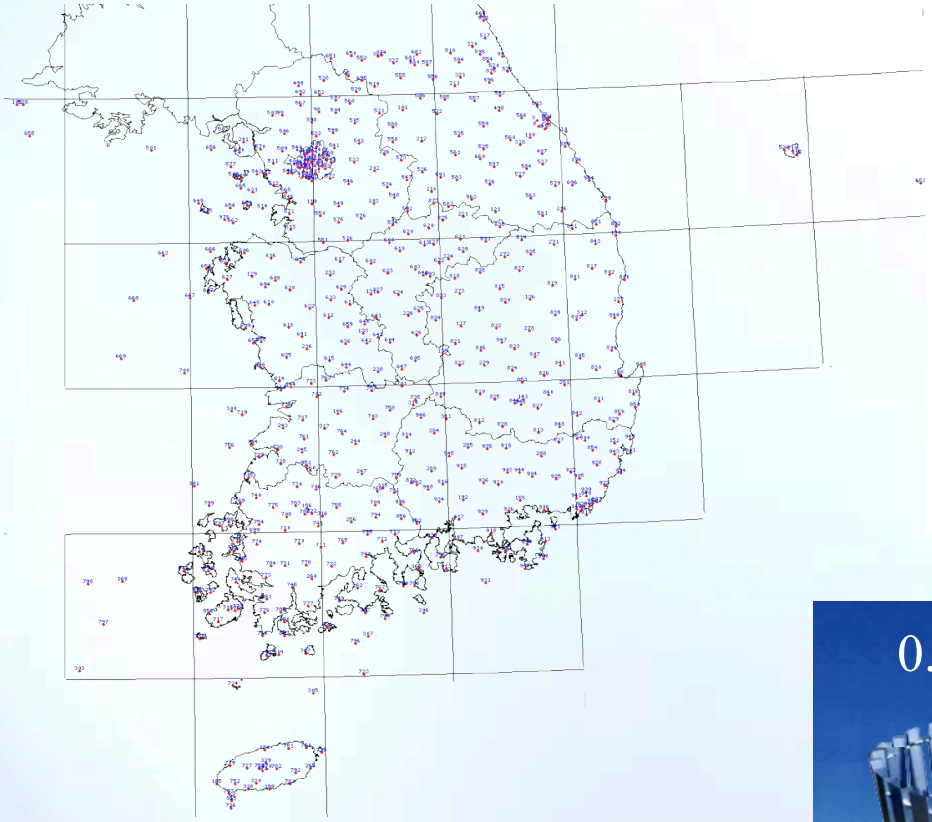
Diverse Conventional Observation

Conventional Weather Stations

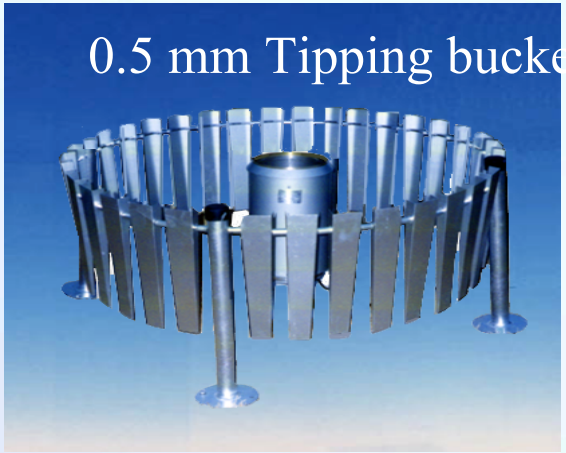
	No. of station	No. of daily ob servation
Surface	76	8-24
Upper-air	10	2-4
Wind Profiler	10	144
Lightening Obs ervation	21	Every 1 min
Moored Buoy	5	24

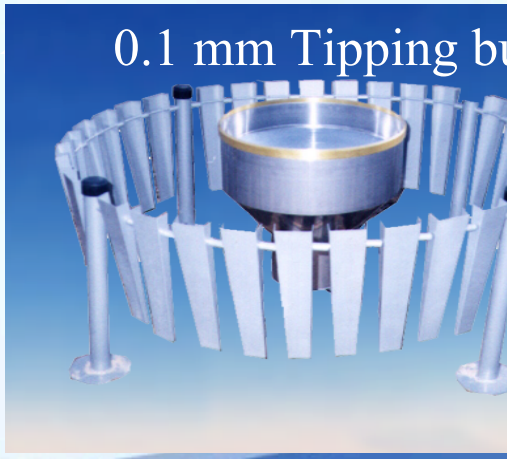
Dense 1-min Raingauge Network

Automatic Weather Station (AWS)



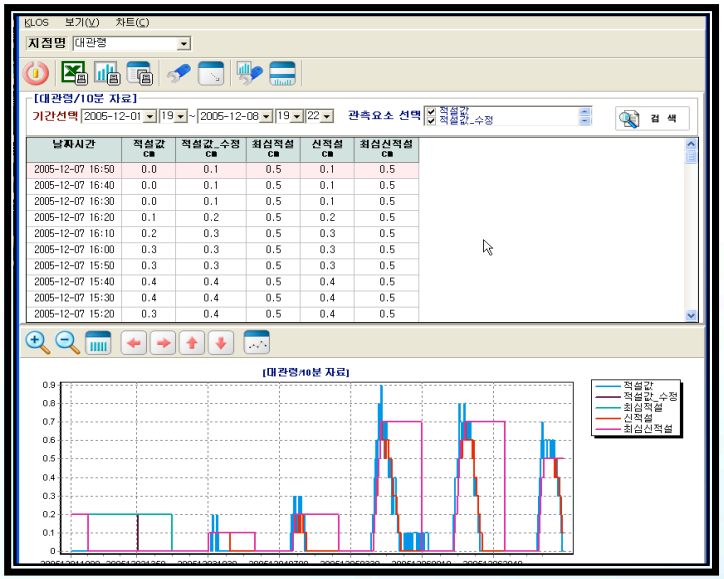
- No. of Stations : 541
- Time Interval : 1 min
- Spacing : ~13 km





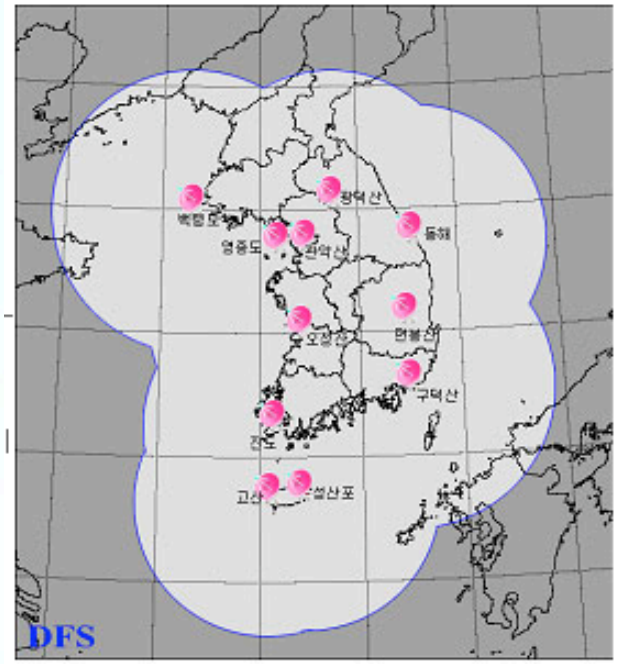
Snow Depth Observation

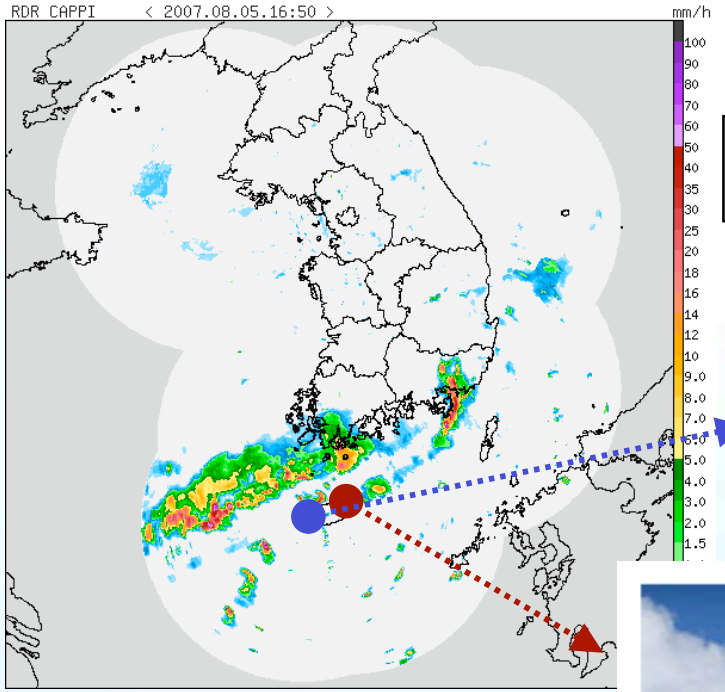
Automatic Snow Depth Measurement System (ASDMS)



- ❖ No. of Station : 71
  - -137 stations by 2010
- ❖ Time Interval : 10 min
- ❖ Spacing : ~ 27 km

12-Radar Network in Operation





Ko-San Radar Si (S-band)

Sung-Sanpo Radar Si (S-band)

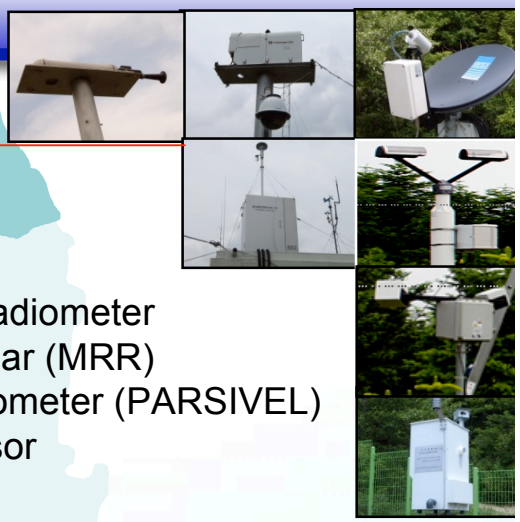
- No. of Radars : 12
  - 4 C-band, 7 S-band
  - 1 X-band portable in KEOP site
- Time Interval : 10-min

Intensive Observation Sites

CPOS

Seoul

Daegwallyeong
- FSSP096
- Microwave Radiometer
- Micro rain radar (MRR)
- Optical Disdrometer (PARSIVEL)
- Visibility Sensor

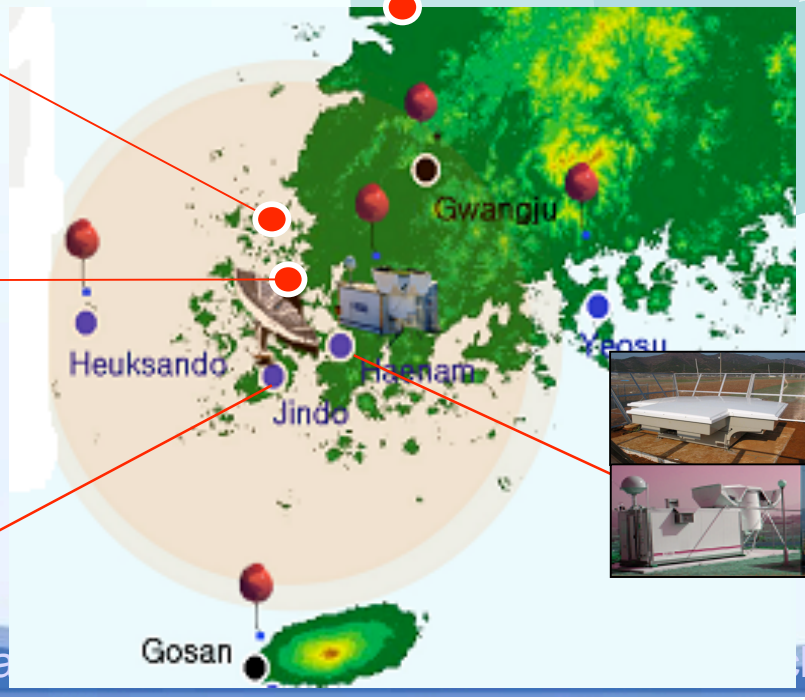


Ohsungsan
S-band radar

Muan X-band
Doppler radar

KEOP

Mokpo



Haenam Enhanced Observation Si
- Wind Profiler
- Autosonde
- Micro Rain Radar (MRR)
- Optical Rain Gauge (ORG)
- Synoptic Weather Observation
- Microwave Radiometer

Jindo S-band
Doppler radar

KEOP Site for Severe Weather

Korean Enhanced Observation Program

- X-band Doppler Radar
- MRR (KNU)

R

- MRR

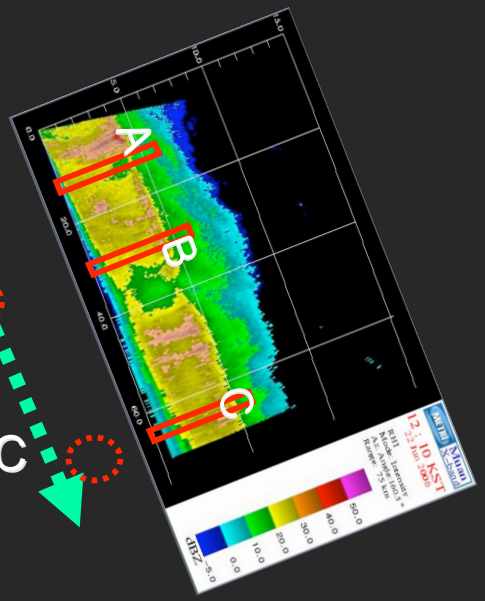
A

- MRR
- ORG
- PARSIVEL

B

- MRR
- ORG
- PARSIVEL (plan)
- Autosonde
- Wind profiler

C



KEOP-2006 IOP

- R : RHI scan with the interval of 1-min
- A: MRR, AWS
- B: MRR, PARSIVEL, ORG, AWS
- C: MRR, ORG, Wind profiler, Autosonde, AWS

Objectives

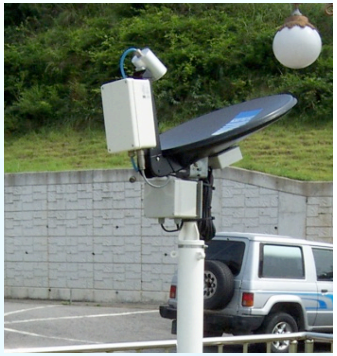
- Analyze the severe weather storm using remote sensing instruments
- Research the drop size distributions of cloud and precipitation
- Improve an estimation of radar intensity using the raingauge grid observation (5 km, plan)

ORG

(Optical Rain Gaug

MRR

(Micro Rain Rad

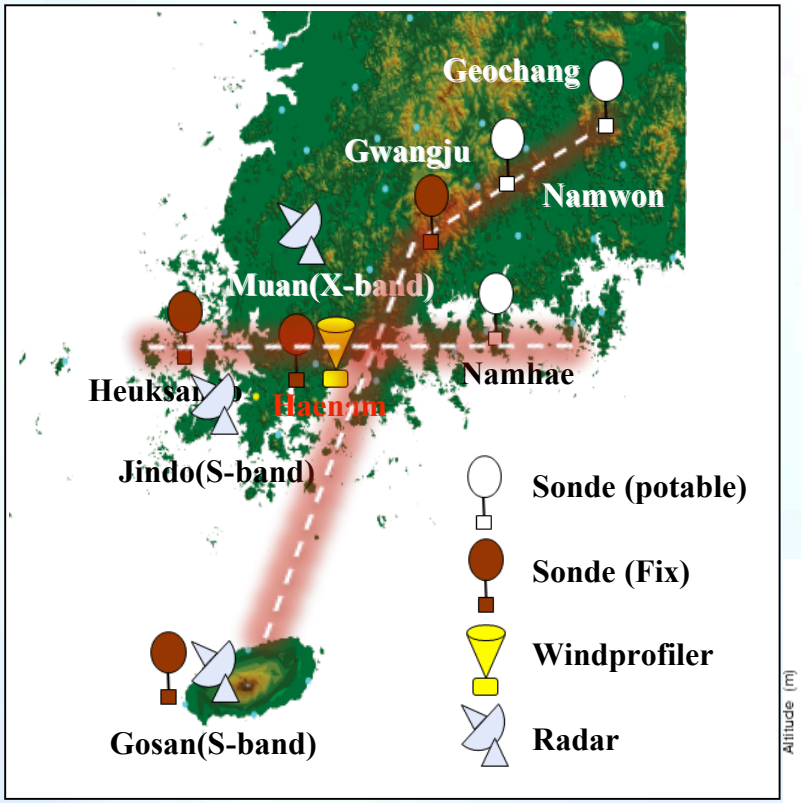


PARSIVEL

(Optical Disdrome

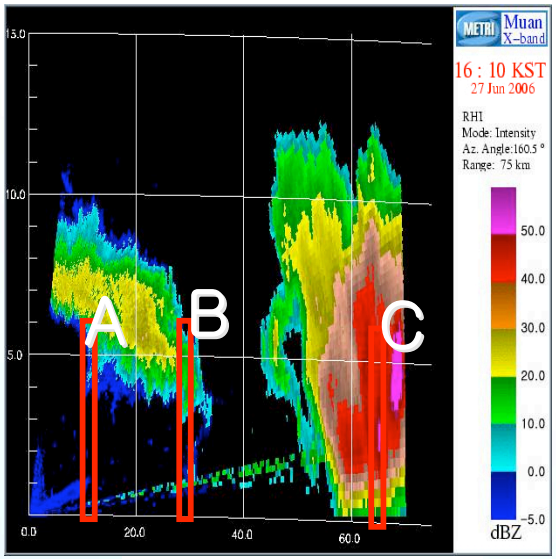
KEOP-2006

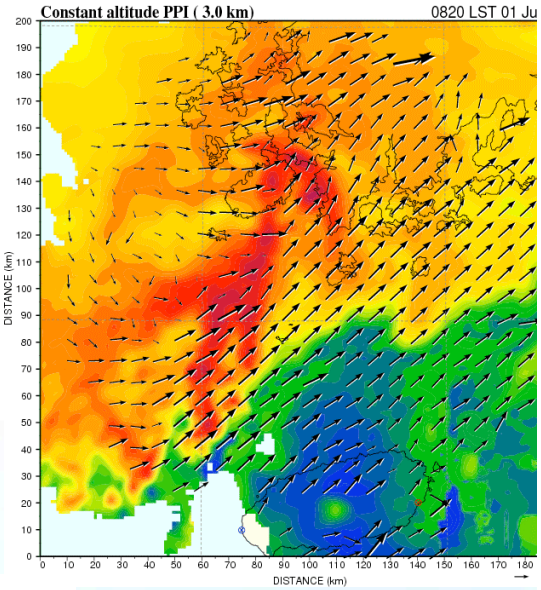
IOP Design

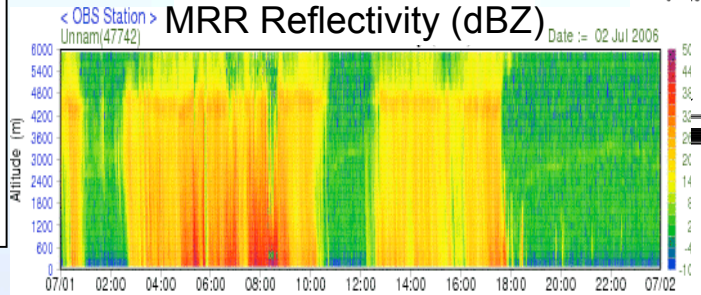


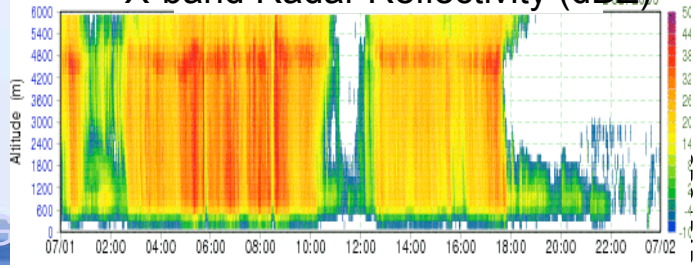
Targeting
-Thunderstorms,
- Changma-front,
- Thyphoon and so on..

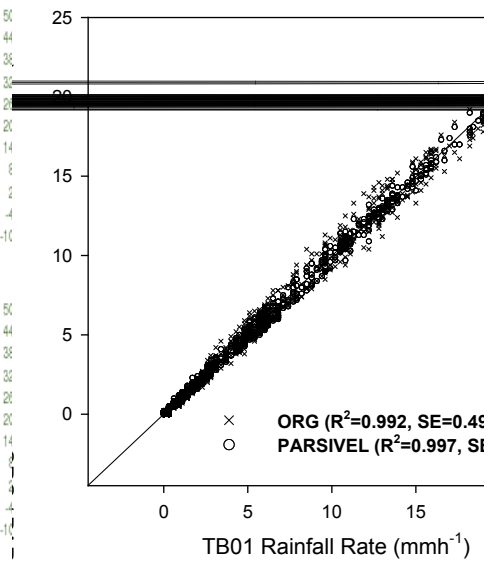
Analysis







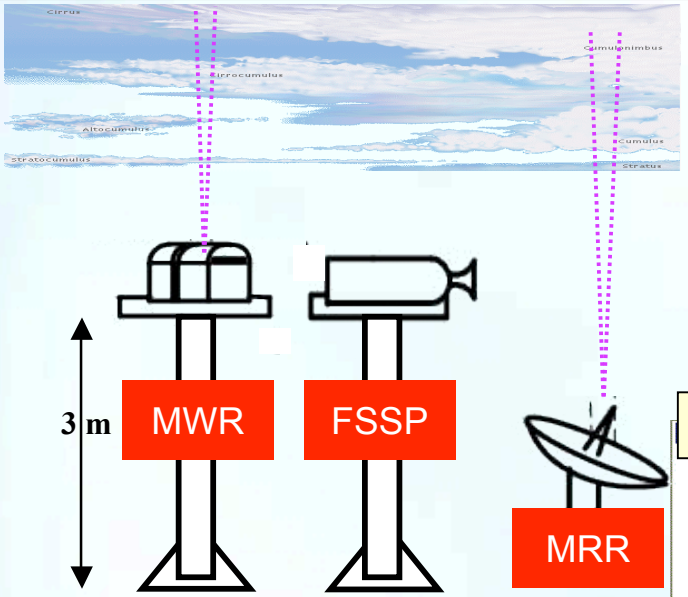




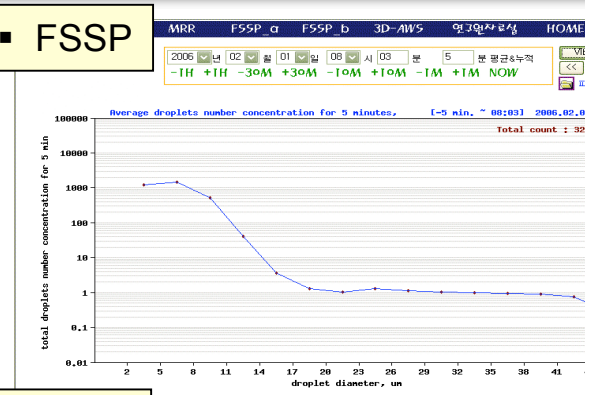
CPOS Site for Cloud Physics

	Measurement	Target	Range	Val. (R^2)	Obs. Sta
PARSIVEL (Disdrometer)	Drop Size & Fall Velocity	Precipitation	0.2 – 25 mm (Diameter)	0.966	'06.05.18
FSSP (Forward Scattering Spectrometer Probe)	Size Distribution	Water Vapor	0.5 – 47 um (Diameter)	1) 31um 2) 0.64	'03.11.27
SVS (Sentry Visibility Sensor)	Visibility	Water Vapor	30 – 16000 m	± 0.075 m	'06.06.15.
MRR (Micro Rain Radar)	Power(dB), Fall Velocity -> Reflectivity, RainRate, LWC	Water Vapor & Precipitable Water	Water Content (gram) in a volume of 50 m column	0.84	'05.04.04.
MWR (Microwave Radiometer)	Radiance -> TPW, LWC	Water Vapor & Precipitable Water	-	0.88 (clear) 0.79 (cloudy)	'03.11.23
3D AWS	u, v, w, T, q	Weather	-		'05.04.27

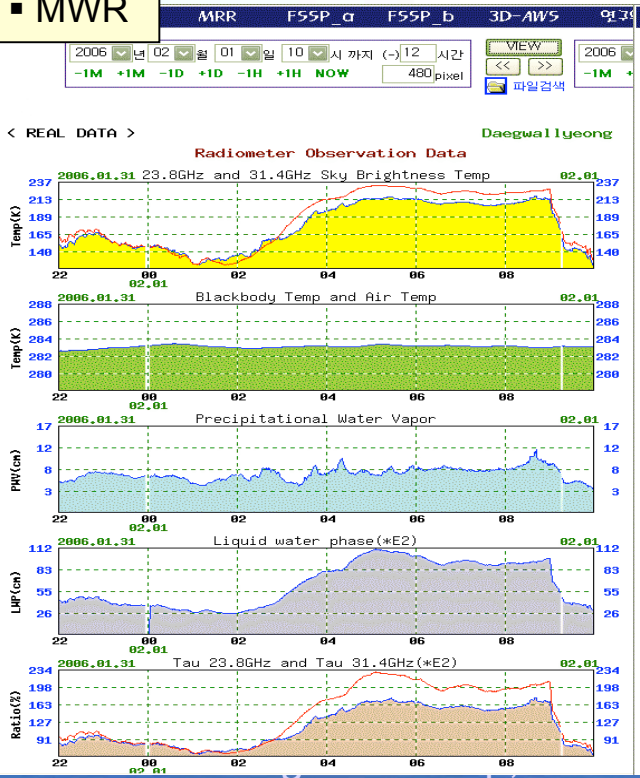
CPOS-Observation Data DB



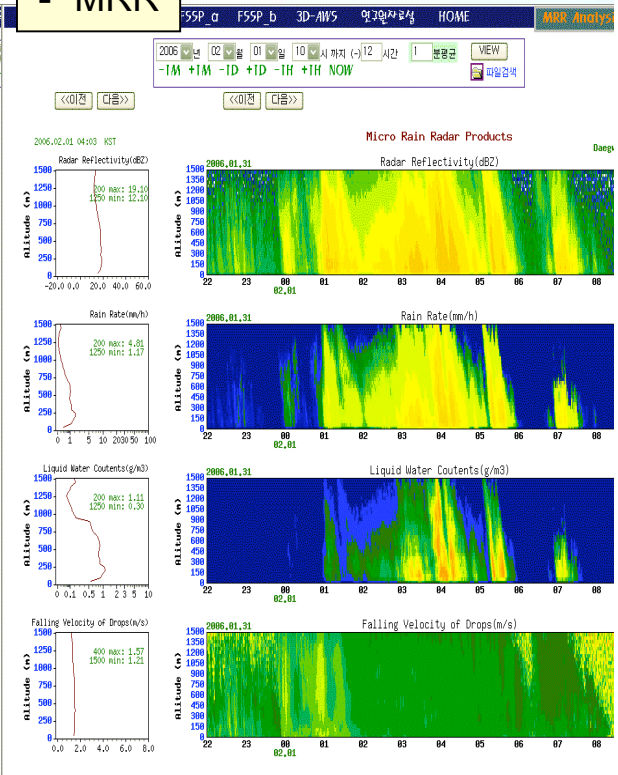
- FSSP



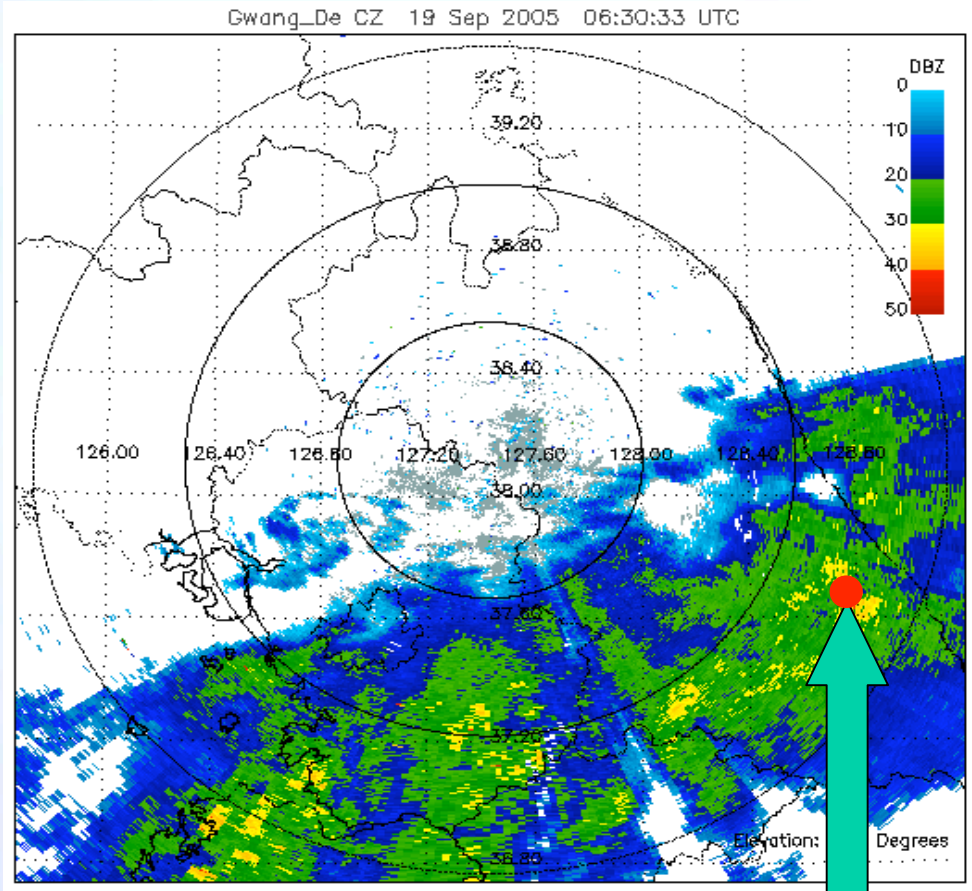
- MWR

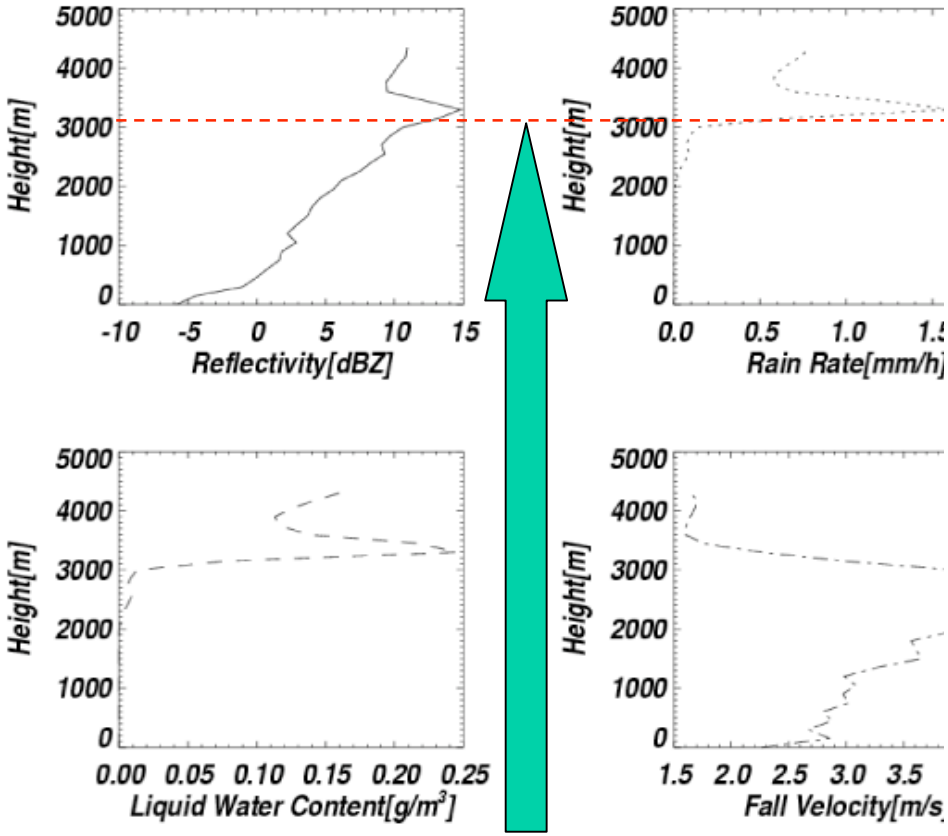


- MRR



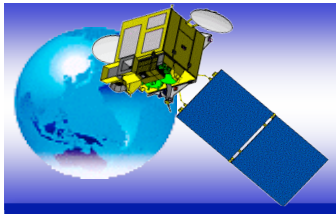
CPOS-Application





MRR

Melting layer



Application of 1-min Raingauge Data over Korea

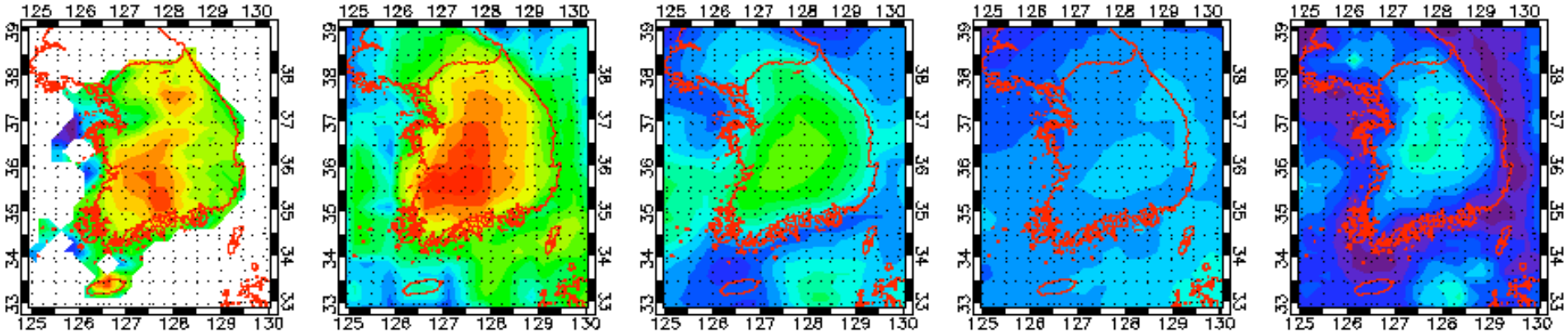
By B. J. Sohn

Seoul National University

Averaged AWS and HRPP rain rates

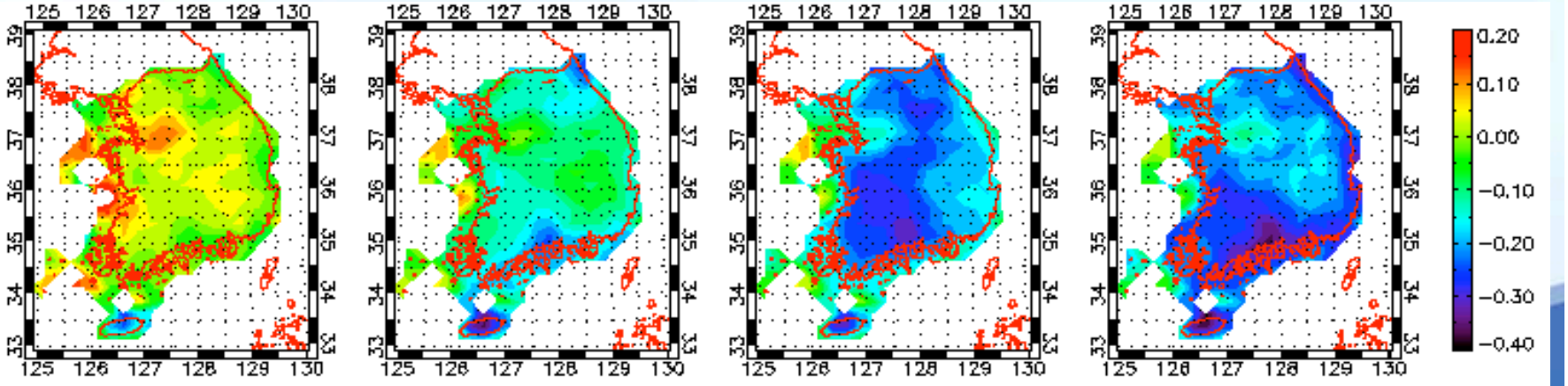
Averaged Rain Rate [mm/hr]
Jun~Aug, 2003~2005

AWS TMPA 3B42 CMORPH PERSIANN NRL-Blended

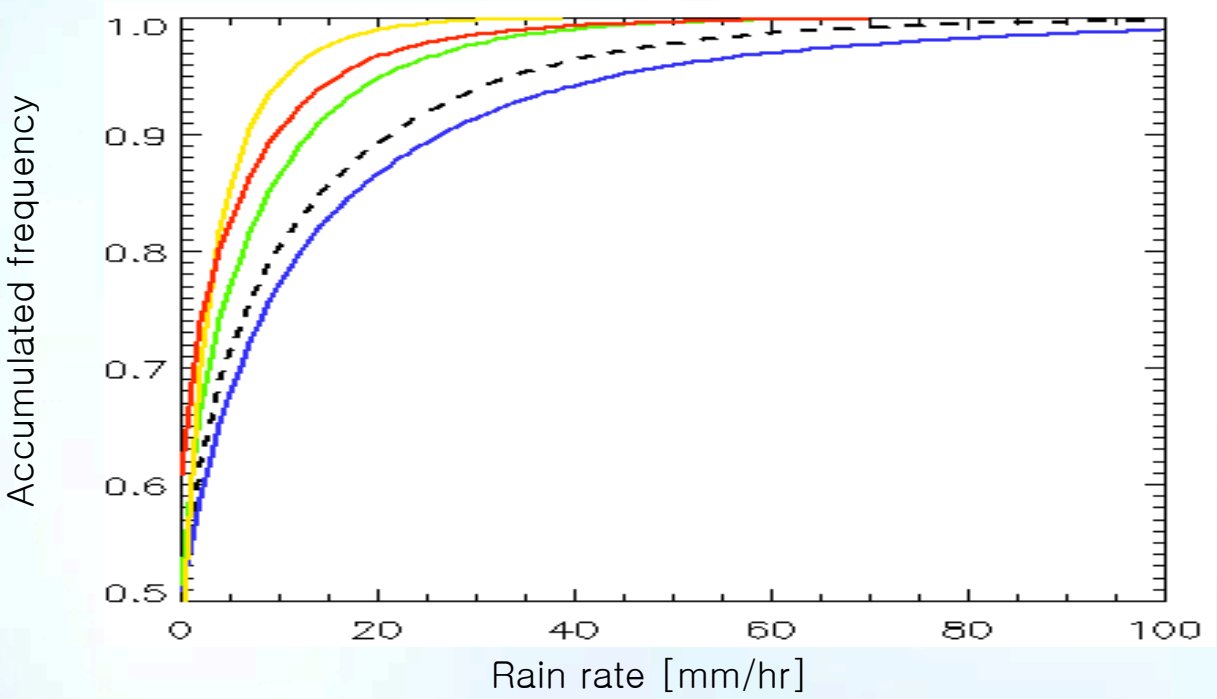


Rain Rate Difference from AWS [mm/hr]

TMPA 3B42 CMORPH PERSIANN NRL-Blended



Accumulated frequency of the observed AWS and HRPP rain rates

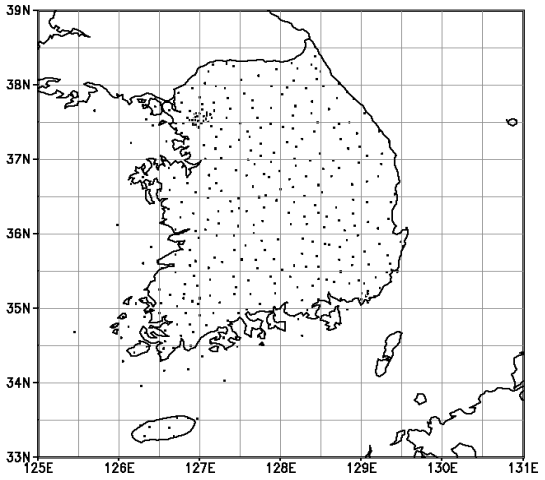


Black dashed line: AWS
Blue line: TMPA 3B42
Green line: CMORPH
Yellow line: PERSIANN
Red line: NRLB

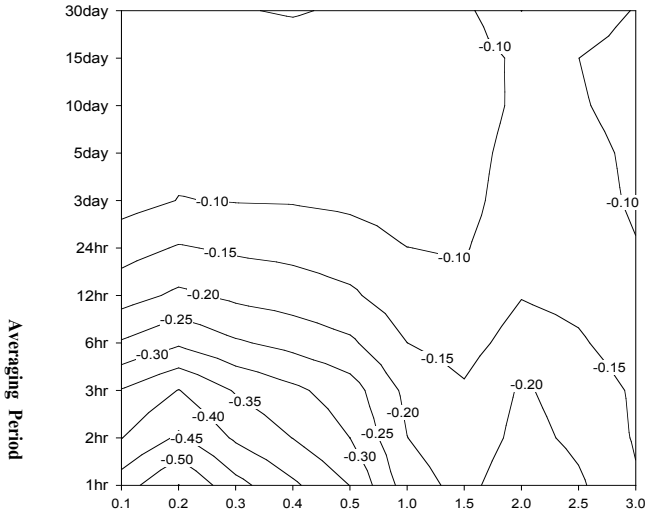
Accumulated frequency the observed AWS and HRPP rain rates
(Grid size: 0.25°, Averaging period: 3hr)

Validation using 1-min AWS data

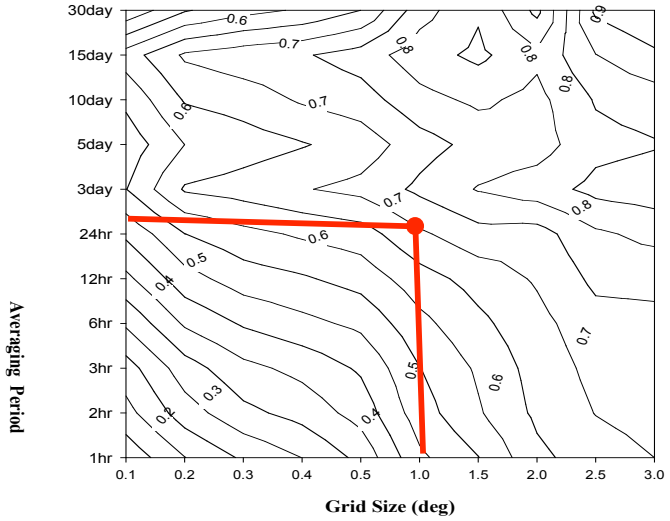
One Minute Raingage Network over Korea



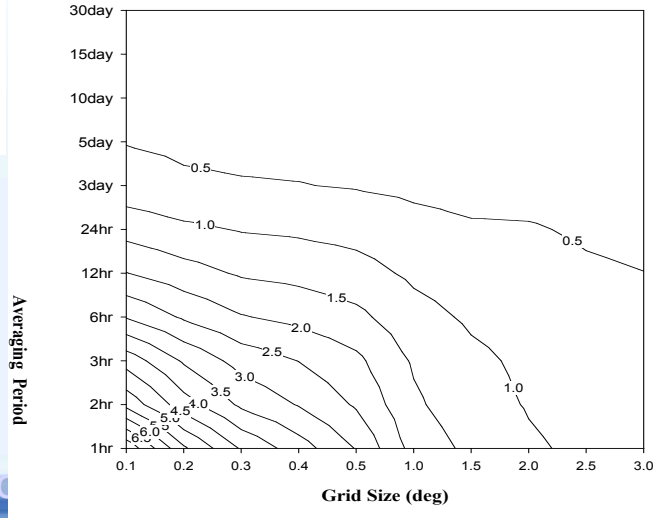
Mean Bias
(AWS time window = ± 10min)



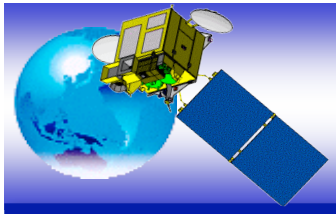
Correlation Coefficient
(AWS time window = ± 10min)

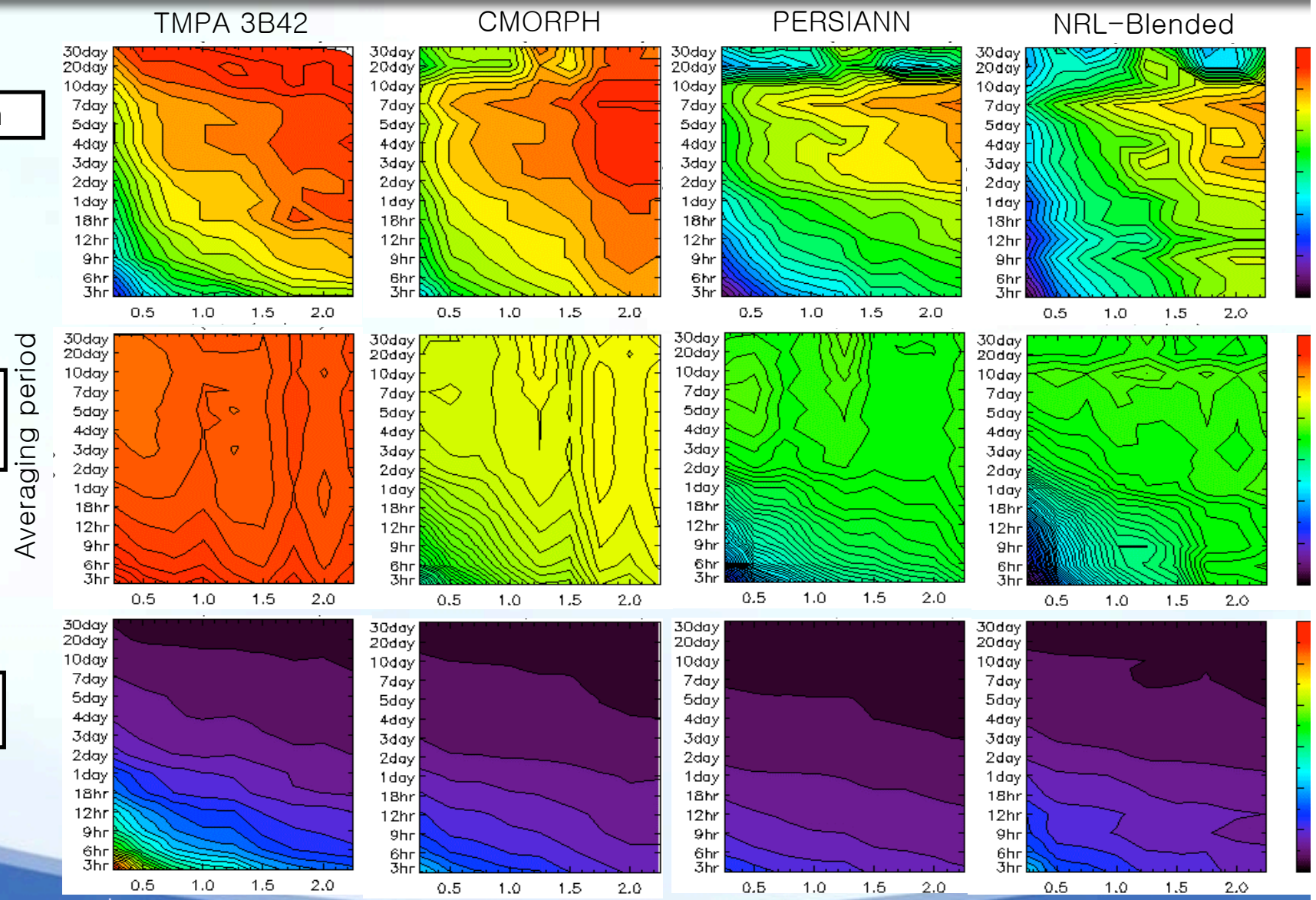


RMS Error
(AWS time window = ± 10min)

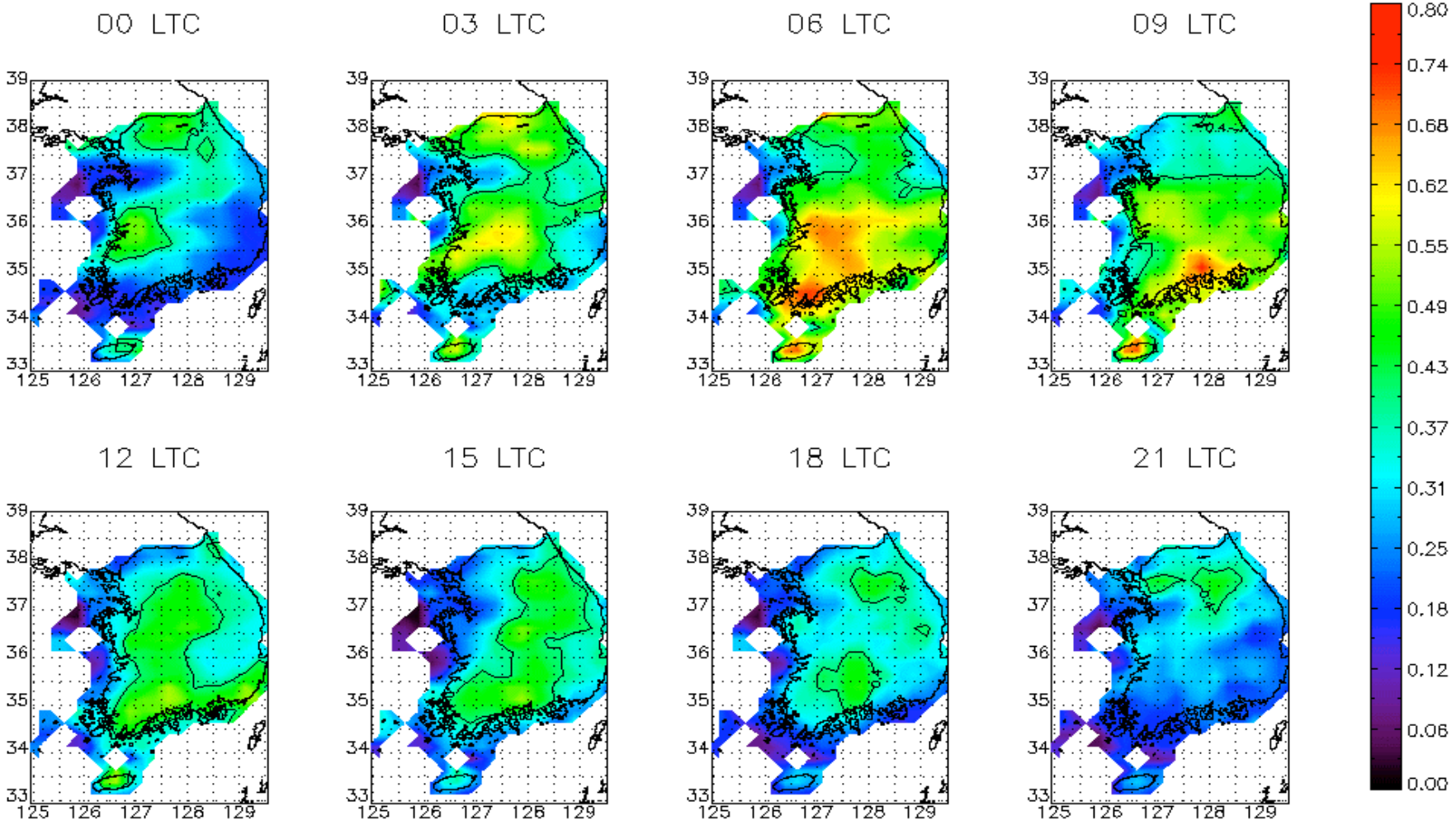


Contour plots of the correlation, mean bias, and RMSE

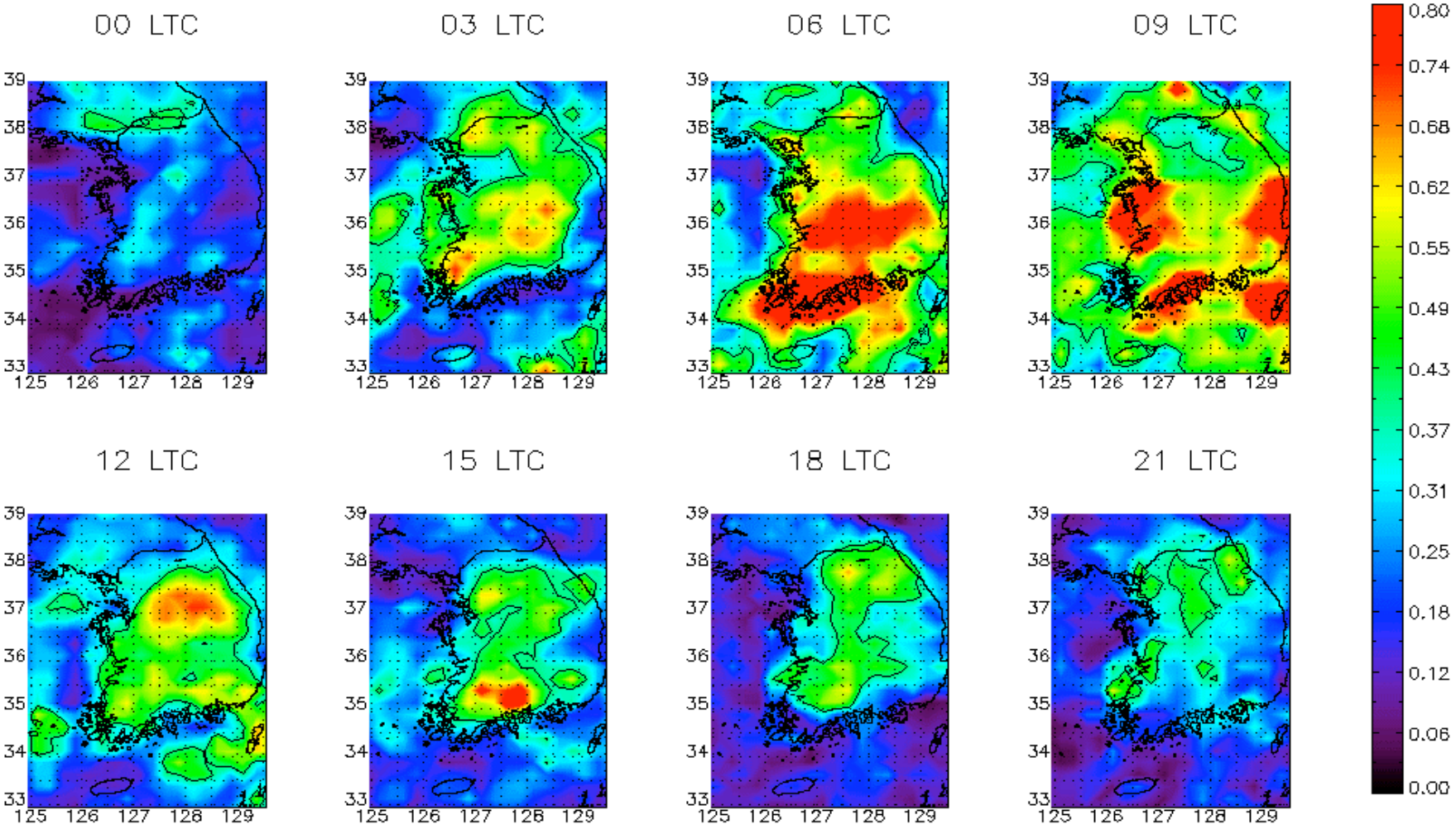




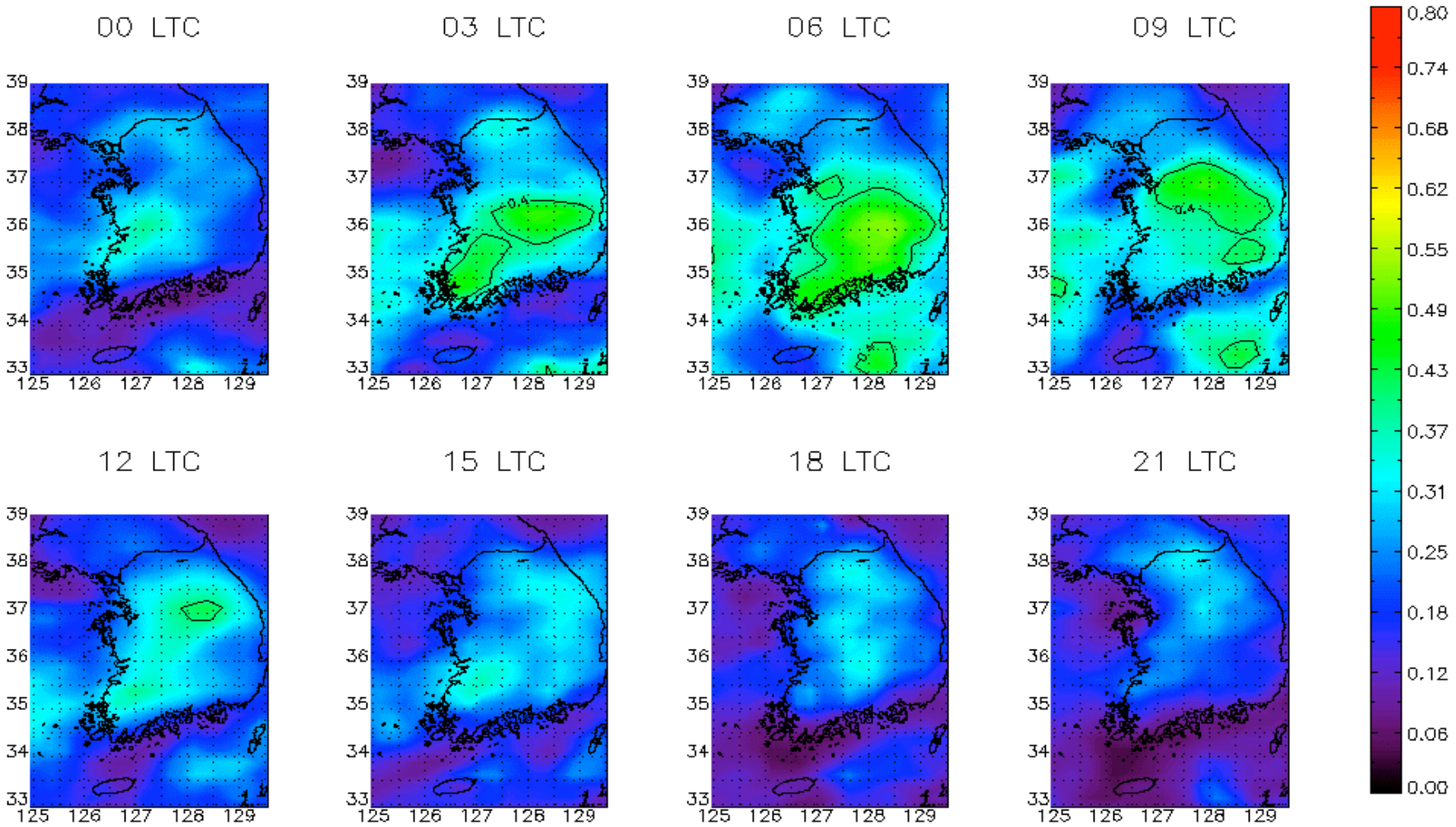
3-hourly averaged rain rates (AWS)



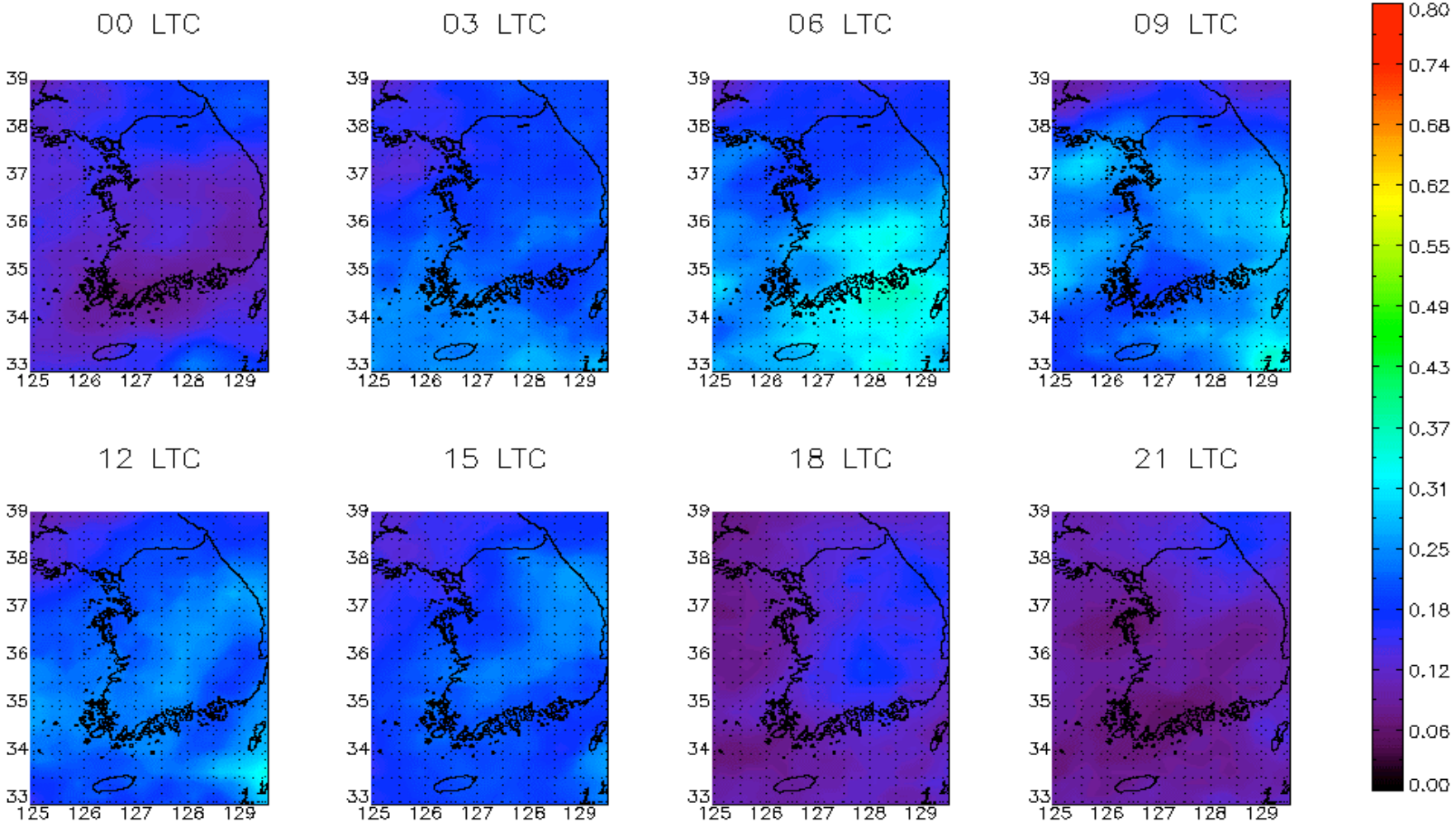
3-hourly averaged rain rates (TPMA 3B42)



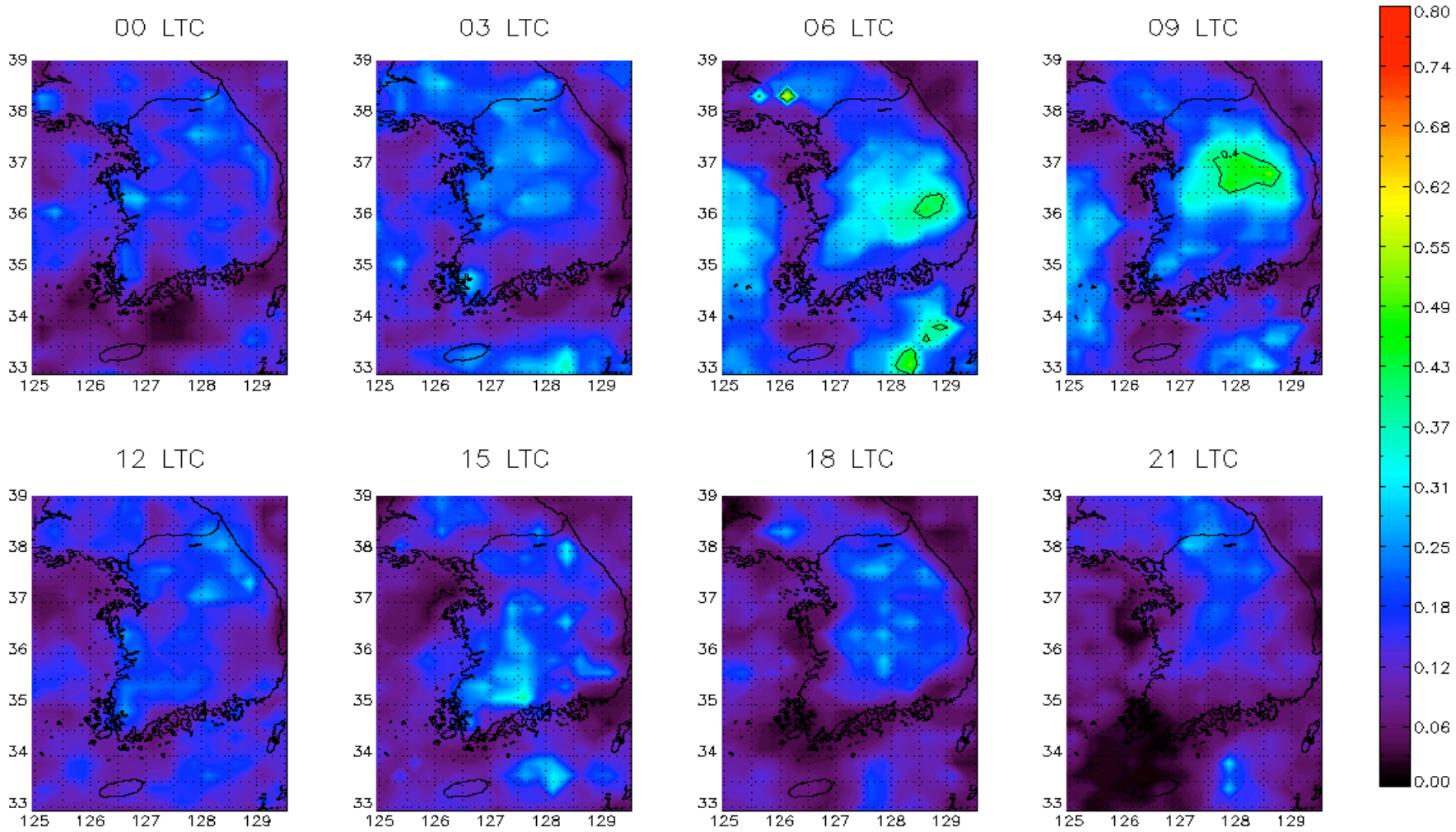
3-hourly averaged rain rates (CMORPH)



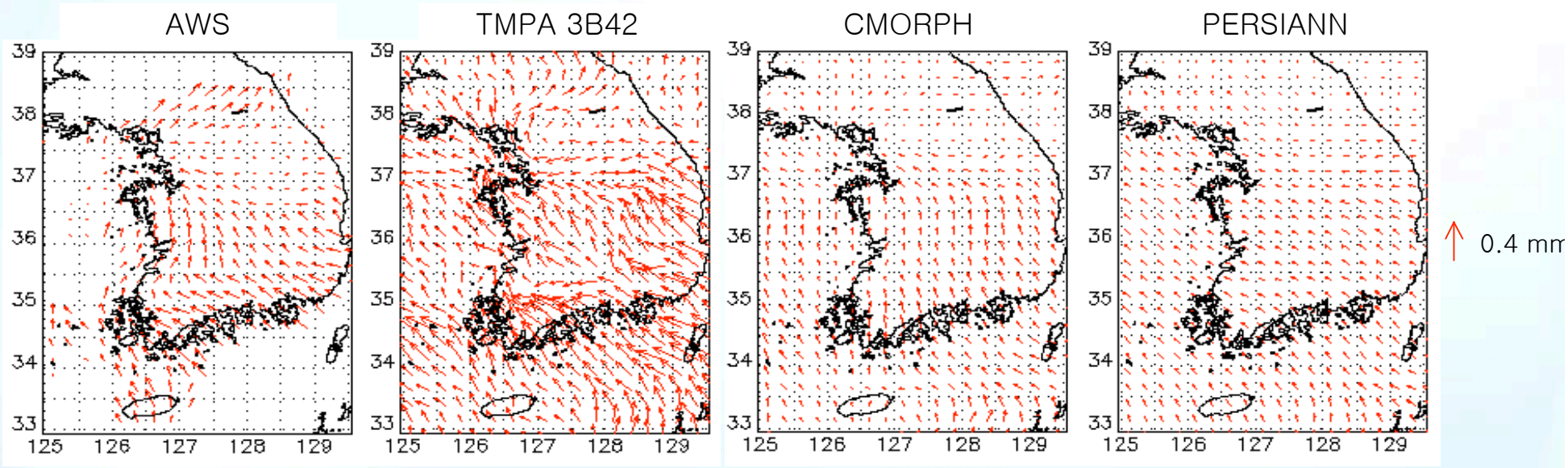
3-hourly averaged rain rates (PERSIANN)



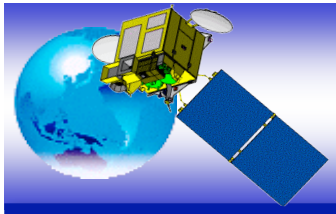
3-hourly averaged rain rates (NRLB)



Harmonic analysis for diurnal variation



Diurnal amplitudes and phases for AWS, TMPA 3B42, CMORPH, and PERSIANN. The length
slant of the arrow means the diurnal amplitudes and phases, respectively.



Plans for GPM GV in Korea

According to GPM GV Strategies

[GV Strategy 1] Statistical Validation of Rainfall

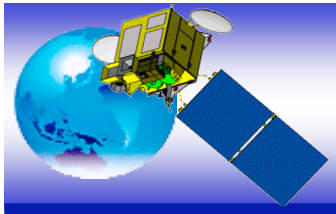
- **Full sets of dense observation data at KMA can be used for pre-launch gorithm development and post-product evaluation.**
  - 1-minute raingauge data for 541 sites (AWS)
  - 10-minute snow depth measurement data (ASDMS)
  - 12-radar network data
- Characterizing the regional observation errors and developing QC procedure

[GV Strategy 2] Physical Validation on Precipitation Process

- Korea is in excellent geographical condition with both mountainous and coas areas, as well as open sea to investigate physical process on precipitation.
- Developing forward/retrieval algorithms and performing data assimilation
- Running 2-intensive observation sites if necessary
- Advancing current algorithms and model performance

[GV Strategy 3] Integrated Hydrometeorology Application

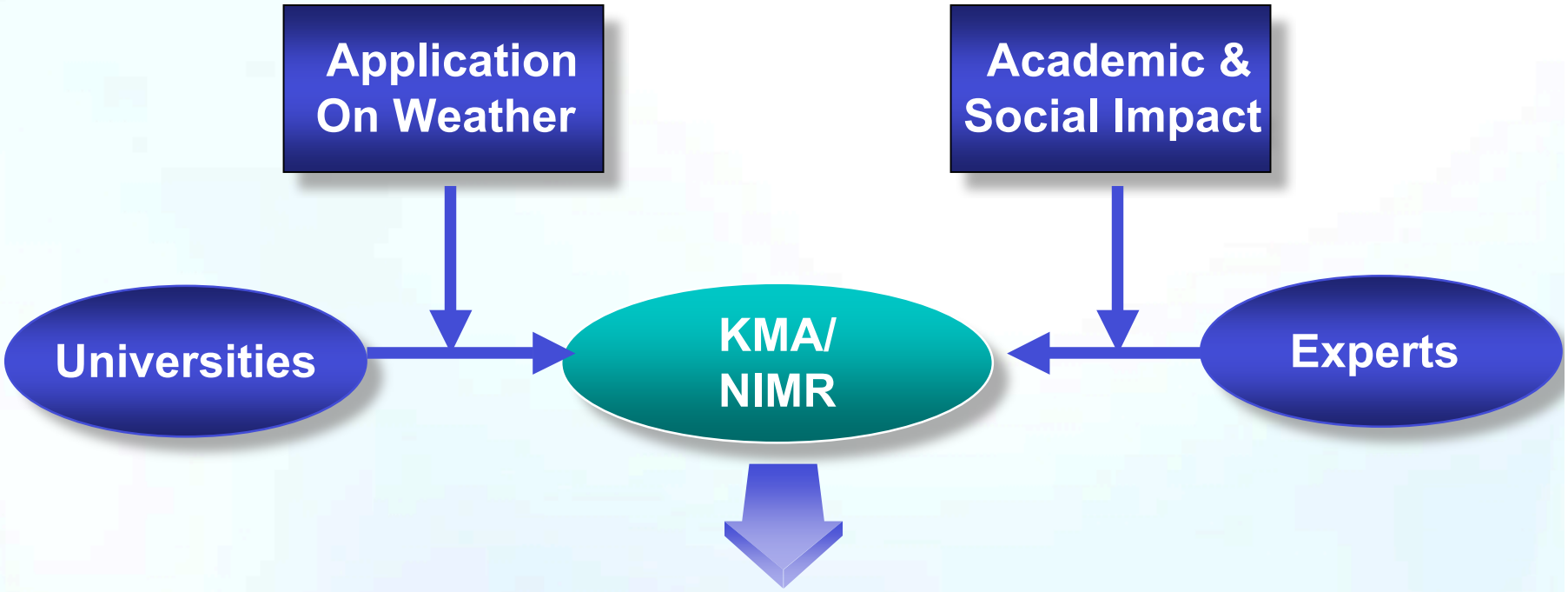
- Need more discussion and collaboration



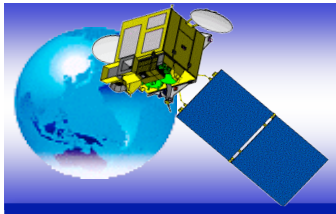
Plans for GPM GV of KMA

- **Others**
  - Plan for additional extension of Korean observation network
    - Microwave Radiometer : 2 → 11 in 2008
    - ASDMS : 71 → 137 by 2010
    - Polarized Radar by 2009

Procedure for Implementation



GPM Application Concept in Korea



GV

I. Basic Rainfall Validation
- Dense 1-min rain data (542 AWS)
- Radar Network(12)
- Snow Depth Observation(71)

Calibration

GPM Satellite Data

Rainfall Retrieval

Confidence GPM Product

Calibration

II. Physical Validation
- Algorithm Development
- Data Assimilation
- Use dense conventional data
- Intensive Observation

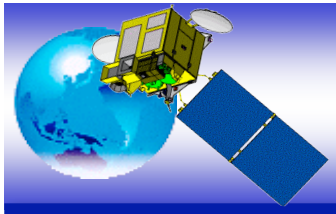
Improve Retrieval Algorithms

Basic Science Modeling Physics, etc.

III. Integrated Application
- Communicate & Collaborate w/ Hydrological Institutes

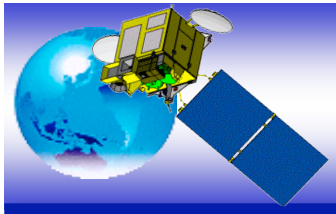
Potential Applications

- Weather Prediction
- Water Management
- Severe Weather Monitoring
- Flood Prediction
- Cloud Microphysics
  Cloud-Radiation Modeling
- Climate Research
- Understanding Weather Phenomena
- Agriculture



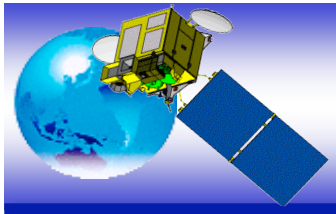
Summary and Recommendations

- KMA is planning to participate in the GPM GV program to ta ke advantages of global precipitation observation.
  - Korean GPM Plan needs to be elaborated to be submitted by com municating with other groups, not just for meteorological purposes t o share the benefits of GPM.
  - Finding collaborating investigators inside/outside of Korea
- There are several excellent conditions in Korea for dense ob servation network, geographical condition for physical valida tion, intensive observation sites, and qualified scientists fro m universities…



Summary and Recommendations

- GPM Data Distribution and S/W tools
  - Supporting accordingly GPM data, other data for Cal/Val and related algorithms to implement the objectives of the research
  - Available data sets and algorithms need to be informed regularly
- Data Qualification
  - Many different instruments, different quality, localized error characteristics….
  - Wonder how to manage them to be equal-qualified.
- Vision and benefits from GPM needs to be shared and opened to worldwide, not just for the GPM partners….
  - Encouraging involvement of meteorological operational society to combine their infrastructures and expertise..



Thank you for listening !!